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PALEONTOLOGY.—Stiptocrinus, *a new camerate crinoid genus from the Silurian.*[1] EDWIN KIRK, U. S. Geological Survey.

In the middle Silurian of the central United States are several species of camerate crinoids that have variously been referred to *Saccocrinus*, *Periechocrinus*, *Carpocrinus* ("*Habrocrinus*"), and *Aorocrinus*. These species cannot be assigned to any described genus. The new genus *Stiptocrinus* is here proposed for their reception.

Stiptocrinus, n. gen.

Genotype.—Stiptocrinus spinosus, n. sp.

Generic diagnosis.—

Crown. The genus is represented by a considerable number of thecae, but the arms are unknown except for their proximal portions.

Theca. As seen, specimens attain a maximum height of approximately 40 mm. In general aspect *Stiptocrinus* strongly resembles characteristic species of *Actinocrinus* from the lower Mississippian. There is a pronounced tendency toward lobation, and the proportions of the cup to tegmen are similar. The dorsal cup is high, averaging about 70 percent of the over-all height of the theca. The dorsal cup ranges from subturbinate to subglobose in shape, with somewhat depressed interradial areas. The tegmen is low and usually has well-defined depressed interambulacral areas. The thecal plates are heavy and typically tumid. The plates of the dorsal cup may be ornamented by discrete subspinous processes, irregular vermicular ridges, or fairly regular radiating ridges. In *S. nodosus* the plates of the dorsal cup are all strongly nodose.

BB. Three subequal elements, usually moderately large and prominent.

RR. In most species the height and breadth of the plates are approximately the same. In some species the height is greater than the breadth. In *S. spinosus* the height is as much as one-third greater than the breadth.

IBrr. The first primibrach is usually considerably smaller than the radial, and the primaxil still smaller.

IIBrr. At least two and in some cases three secundibrachs may be considered as incorporated in the cup. As a rule the *IIBrr* diverge from the wall of the theca, giving the genus its typical lobate form. The secundibrachs are very stout and the two ranges are typically closely appressed laterally so far as preserved. In species where there is a small intersecundibrach, the brachials enclose it completely.

Interradii. The posterior interradius is very much larger than the others. The primary anal is equal in size to the *RR* and is followed by the usual batocrinoid range of three plates. Distad the plates have a somewhat irregular arrangement. There is a median series of plates decreasing in size distad. In most specimens there are but two or three plates in this vertical series, but in a few cases there are more. The posterior interradius reaches its maximum breadth at the level of the third range, which consists of five plates. In the other interradii the first plate is relatively small, followed by two plates in each of the following ranges.

Tegmen. The tegmen is a low, arched, competent structure. It is composed of numerous small stout plates. The anal tube is excentric in position. In all specimens known it has been broken off. Judged by the diameter at the base, it was unusually large for crinoids of this size.

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Arms. The maximum number of *IIBrr* found in place in any specimen seen is four in series. At this level the two series of a ray are typically closely united. The structure suggests a radial trunk, such as is found in *Melocrinus*. Indeed, some of the specimens found in the collections had been identified as *Melocrinus*. Distad the rami probably separate. Associated with a crushed theca of uncertain specific affinities are two fragments of what appear to be discrete rami. They are laterally displaced, but seem to belong to the specimen. If such be the case, the rami are stout and uniserial.

Column. The column itself is unknown. From the impression on the basals is appears to have been relatively large. In one specimen the lumen shows clearly. It is pentalobate.

Distribution.—*Stiptocrinus* has been recognized in the Cedarville dolomite of Ohio and Indiana, the Racine dolomite of Illinois, the Laurel limestone of Indiana, and the Decatur limestone of Tennessee. There is a specimen in the Springer collection formerly labeled *Dimerocrinus inornatus* and stated to come from the Waldron of Hartsville, Ind. It is a *Stiptocrinus*. At St. Paul, Ind., the specimens seem to come from several horizons and localities. Unfortunately, the original locality labels were not transcribed when the specimens were put in the collections.

Remarks.—The only genus with which *Stiptocrinus* need be compared is *Periechocrinus*. *Saccocrinus*, as based on the type species *Saccocrinus speciosus*, cannot be separated from *Periechocrinus*. *Periechocrinus* has relatively very thin plates and an incompetent tegmen made up of a great many small plates. The plates of the cup, particularly in the radial series, are typically very high in proportion to the breadth. Many of the plates of the higher ranges of the radial series are incorporated in the cup. The anal tube is a short incompetent structure, usually found flattened down on the tegmen. *Stiptocrinus*, as may be seen in the description given above, differs to a marked degrees in all the characters enumerated.

Species referred to the genus.—

Stiptocrinus benedicti (S. A. Miller), n. comb.

Saccocrinus benedicti S. A. Miller, 1892, p. 29, pl. 5, figs, 1, 2, "Niagara Group, at St. Paul, Indiana" (Laurel limestone).—S. A. Miller, 1894, p. 283, pl. 5, figs. 1, 2.—Springer, 1926, p. 46, pl. 10, figs. 6–10 (*non* figs. 11–14).

Periechocrinus ornatus (Hall) (*pars*), Wachsmuth and Springer, 1897, pl. 51, fig. 7.

Not *Habrocrinus benedicti* Slocom (*non* Miller) (=*Stiptocrinus chicagoensis* (Weller), 1908, p. 295, pl. 87, figs. 6, 7.—Foerste (*non* Miller) (=*Stiptocrinus* sp.), 1917, p. 243, pl. 10, figs. 5a, 5b.

This is apparently the most abundant species of *Stiptocrinus* in the Laurel limestone at St. Paul, Ind. There are 30 or more specimens of the species in the Springer collection, not counting 4 specimens figured by Springer, but here removed from the species. At least 15 of these specimens are in good to excellent state of preservation and represent a considerable range in growth stages.

The maximum height of theca among known specimens is shown by one of Miller's types, which gives 30 mm. Most specimens have a height of 25 mm or less.

The characteristics of the species are well shown by Springer's figures (1926, pl. 10, figs. 6–10). The plates of the dorsal cup, as shown in fig. 7 are incorrectly drawn. The radials appear to be considerably higher than wide. Such is not the case, as the dimensions are nearly equal.

Specimens shown in Springer's figs. 11 and 12 have been removed from *S. benedicti* and placed in a new species, *S. spinosus*. Specimen Fig. 13 represents still another species. As shown in the tegminal view it is deeply lobate. *S. benedicti* is only slightly lobate. The dorsal cup of fig. 13 is unlike that of either *S. benedicti* or *S. spinosus*. Specimen fig. 14 is here described as *S. carinatus*.

Stiptocrinus carinatus, n. sp.

Saccocrinus benedicti Springer (*non* Miller) (*pars*), 1926, pl. 10, fig. 14.

This species is given a name chiefly to record its aberrancy in form and ornamentation. As holotype I choose the specimen figured by Springer, pl. 10, fig. 14. The specimen is a fragmentary dorsal cup, preserving the posterior interradius and three rays. The specimen is somewhat crushed. The tegmen is missing, and the wall of the cup is preserved up to and including the first secundibrachs. A smaller specimen, not figured, has a complete dorsal cup, preserved to the same level as the larger specimen. This will stand as a paratype. There is another specimen, larger than the holotype, poorly preserved, and partially embedded in matrix.

The cup is broader than high, the small specimen having an average diameter of 15 mm and a height of 12 mm. The walls of the cup diverge more widely than any described species of the genus, excepting *S. nodosus*. The typical plate ornamentation consists of sharp carinae radiating from the center of the plate to each angle. This is unusual, as radiating ridges usually run normal to the faces of the plate. The basals bear irregular vermicular rounded ridges.

The widely expanding walls of the dorsal cup and the stellate ornamentation of the plates readily distinguish this species from any described form.

Horizon and locality.—Laurel limestone, St. Paul, Ind. All three specimens are partially silicified and come from a dolomitic limestone.

Types.—The types are in the Springer collection, United States National Museum. Holotype S 4473; paratype S 4474.

Stiptocrinus chicagoensis (Weller), n. comb.

Periechocrinus chicagoensis Weller, 1900, p. 131, pl. 13, figs. 7, 8, Niagaran, Bridgeport and Joliet, Ill. (Racine dolomite).

Habrocrinus benedicti Slocom (*non* Miller), 1908, p. 295, pl. 87, figs. 6, 7.

This is the largest described species of *Stiptocrinus*, the height of the theca ranging up to 40 mm or more. It is difficult to form an adequate picture of the species. Except for the portion of the exterior figured by Slocom, all we have are internal casts. The *RR* are higher than wide, and the primibrachs are relatively larger than in any other described species. There seem to be no intersecundibrachs.

Because of its large size and the proportions of the plates, it would seem advisable to keep this species distinct.

Stiptocrinus farringtoni (Slocom), n. comb.

Habrocrinus farringtoni Slocom, 1908, p. 296, pl. 87, figs. 1–5, "Niagaran limestone—about 1 mile east of Lemont, Illinois" (Racine dolomite).

Stiptocrinus howardi (S. A. Miller), n. comb.

Saccocrinus howardi S. A. Miller, 1892, p. 30, pl. 5, figs. 3–5, "Niagara Group, at St. Paul, Indiana" (Laurel limestone).—S. A. Miller, 1894, p. 284, pl. 5, figs. 3–5.

Habrocrinus howardi (Slocom), 1908, p. 297.—Foerste, 1917, p. 243.

The validity of this species is questionable. Not having seen the specimen itself, I am not competent to pass judgment. In the Springer collection I have chosen one specimen that may represent this species. In form of theca this specimen resembles *S. benedicti*, and the ornamentation is similar. The theca, however, is strongly lobate, and there are no intersecundibrachs. It does not have the broadly truncate base and subcylindrical cup described by Miller. Indeed, in a hundred or more specimens of *Stiptocrinus* from St. Paul I have seen no specimens corresponding to Miller's.

Stiptocrinus nodosus (Springer), n. comb.

Aorocrinus nodosus Springer, 1926, p. 47, pl. 10, figs. 16, 16a, 16b, "Decatur limestone, Niagaran; below Grandview, 10 miles above Clifton on the Tennessee River, Perry County, Tennessee."

I think there can be little doubt that this species is referable to *Stiptocrinus*. The radial series is not preserved beyond the first secundibrachs, but all the structures shown agree with those of the genus.

Stiptocrinus spinosus, n. sp.

Saccocrinus benedicti Springer (*non* S. A. Miller) (*pars*), 1926, pl. 10, figs. 11, 12.

There are 15 specimens of this species in the Springer collection, two of them figured by Springer as *Saccocrinus benedicti*, as noted above. The specimen illustrated by fig. 11 is chosen as holotype of *Stiptocrinus spinosus*. The other specimen (fig. 12) will stand as a paratype.

This is one of the smaller species of the genus. The theca of the holotype, an adult individual, has a height of 20 mm, which seems to be about average for the species. The paratype, an imperfect specimen lacking the tegmen and *IIBrr*, would have had a height somewhat greater than this.

The theca is strongly lobate, more so than any described species of the genus. The dorsal cup is high, making up about four-fifths the over-all height of the theca. The sides of the cup diverge evenly at an angle of about 45°. The tegmen is low, with strongly depressed interambulacral areas.

In the dorsal cup perhaps the most characteristic feature of the species is the proportionally very large radial, and its considerable excess in height over breadth. In the holotype the average height of the radials is approximately one-third greater than the breadth. The secundibrachs diverge sharply from the wall of the cup, giving the strongly lobate form characteristic of the species. There are no intersecundibrachs.

The ornamentation of the plates of the cup is unlike that of any known species. In the holotype each basal element bears a pair of subspinous processes. In gerontic individuals, such as the paratype, there is a considerable accretion of sterom. The space between the processes is partially filled, and the lateral elevations are extended distad as rounded ridges. Subsidiary spinous processes may also appear. The radials and the primary anal each typically bear a subcentral spinous process. In gerontic forms two or three less elevated nodes appear below the central node, and low rounded ridges may develop. Each of the first primibrachs bears a central node that tends to extend laterally into a ridge. The plates of the interradial series also have more or less sharply defined central nodes. The pronounced lobation, lack of intersecundibrachs, spinous ornamentation, and the relatively narrow straight-sided dorsal cup clearly distinguish *S. spinosus* from *S. benedicti*. The shape of the cup and the ornamentation are quite unlike that seen in *S. howardi*.

Horizon and locality.—Laurel limestone, St. Paul, Ind. Two specimens can be placed more accurately as from the "State House Quarry."

Types.—The holotype and paratype are in the Springer collection, United States National Museum. Holotype S 4471; paratype S 4472.

The following two specimens will be noted merely because of their stratigraphic position and publication. Neither, owing to poor preservation, can be determined specifically.

Stiptocrinus sp.

Habrocrinus benedicti Foerste (*non* Miller), 1917, p. 243, pl. 10, figs. 5a, 5b, "Muncie, Indiana, above the horizon of the Cedarville dolomite."

This is a large species, fully as large as *S. chicagoensis* and similar to that species.

Stiptocrinus sp.

Habrocrinus sp. Foerste, 1917, p. 242, pl. 10, fig. 6, "Cedarville dolomite—Mills Quarry, one mile southwest of Springfield, Ohio."

This specimen is of medium size and strongly lobate. It most nearly resembles *S. spinosus*, but the walls of the cup diverge more widely, and it is much larger than any known *S. spinosus*. The ornamentation seems to consist of irregular vermicular ridges.

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